Mechanisms for Funding High-Risk, High-Reward Research

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In recent years, the scientific community has increasingly come to believe that our current national R&D portfolio has become too conservative and encourages only incremental advances in science and technology. As a result of this worry, there have been a number of calls for funding increases for research of high-risk, high-payoff nature. A National Science Board report sums up the sentiment of the community:

> The underlying concern … is that failure to encourage and to support revolutionary ideas will jeopardize not only our Nation's ability to compete in today's and tomorrow's global economy, but also the progress of science as a whole. This concern is articulated best in the much publicized and widely heralded 2005 report from The National Academies *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*. The authors identify factors that contribute to the United States' eroding competitiveness in the global economy; the recent decline in support of "high-risk or transformative research," particularly in the physical sciences, engineering, mathematics, and information sciences is identified as one major factor. The authors state that "reducing the risk for individual research projects *increases* the likelihood that breakthrough, 'disruptive' technologies will not be found—the kinds of discoveries that yield huge returns." [i]

The now 50-year-old Department of Defense's Defense Advanced Research Program Agency (DARPA) is often cited as a successful high-risk, high-reward program model, and programs have attempted to replicate DARPA's model (e.g. HS-ARPA[ii], I-ARPA[iii]); a new ARPA-E to advance energy research is the most recent high-risk, high-reward program to be molded off of DARPA.[iv] Despite the near-consensus that high-risk research is an essential component of a national R&D portfolio, there has been neither much study as to the range of mechanisms for funding of such research nor a development of 'best practices' on how to manage these unique research programs. Anecdotally, it is understood that different existing programs operate with distinct philosophies on how to best fund and manage high risk research. DARPA, for example, traditionally funds project-based assignments that are aimed at overcoming a well-defined challenge.[v] Funding recipients are judged on whether they have met specific milestones and funding can be cut if those milestones are not met. On the other end of the spectrum, the NIH Director's Pioneer Award (NDPA), in its first year, looked to select awardees based on the caliber of the scientists who applied, with a lesser focus on the actual project they proposed to undertake with the funds. In fact, NDPA is designed to allow for extreme research flexibility, so that researchers may completely change research directions during their award period.[vi]

The Science and Technology Policy Institute has, over the last five years, received four separate grants from the National Institutes of Health to study its set of high-risk, high-reward research grant programs: in particular, its NIH Director's Pioneer Award (NDPA) and New Innovator Award (NIA) programs. In this presentation, we propose to discuss our assessment of the these and the other various mechanisms for funding of high-risk, high-reward research programs in the Federal Government, based on data availability.

The question we specifically intend to answer is: what are the various mechanisms for funding high-risk research, and how do their underlying philosophies affect the identification and management of such research? To the extent possible, we will also explore whether these programs have been evaluated. Lastly, we will identify best practices in both managing and evaluating high-risk research programs.

Our primary data source will be official documentation from the programs, as well as synthesis of interviews conducted to supplement or clarify the information collected.

To date, the following programs within the Federal Government have been examined.

> NIH's NDPA; NIH's NIA; NIH's NIDDK New Innovator Award; NIH's Transformative R01 program; NIH's Exceptional Uncoventional Research Enabling Knowledge Acceleration (EUREKA) Program; NIH's Outstanding New Environmental Scientists (ONES): NIH's NCI Unconventional Innovations Program; NIST's Technology Innovation Program; DOD's National Security Science and Engineering Faculty Fellowship; DOD's DARPA; DHS's HSARPA; DNI's IARPA; DOT's Exploratory Advanced Research Program (EARP); NSF's Small Grants for Exploratory Research (SGER) and NSF's Emerging Frontiers in Research and Innovation (EFRI).

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i National Science Board, *Enhancing Support of Transformative Research at the National Science Foundation*. October 2007.

[ii] https://www.hsarpabaa.com/ We note that while HSARPA is modeled after DARPA, it is in fact quite different as the vast majority of its funds are directed towards identified Department of Homeland Security needs rather than disruptive, breakthrough technologies. This difference, among others, will be further described in the complete study.

[iii] http://www.iarpa.gov/

[iv] http://science.house.gov/legislation/leg_highlights_detail.aspx?NewsID=1235

[v] "Power Play," W. B. Bonvillian, The American Interest, Volume II, p 39, November-December 2006

[vi] Despite its name, the NDPA is not intended to be a reward for past achievements, but a competitive grant for conducting research.